of an inch apart, so that in order to be able to see the double star ξ Ursæ, which is a 1″ star, by means of an eight-inch object-glass, all the surfaces, the 50 square inches of surface, of both sides of the crown, and both sides of the flint glass, must be so absolutely true and accurate, that after the light is seized by the object-glass, we must have those two stars absolutely perfectly distinct at the distance of the seventeen hundredth part of an inch, and in order to see stars $\frac{1}{2}$″ apart, their images must be distinct at one-half of this distance or at $\frac{1}{3400}$th part of an inch from each other.

J. NORMAN LOCKYER

(*To be continued.*)

BIOLOGICAL NOTES

CLASSIFICATION OF DECAPOD CRUSTACEANS.—In this well-defined group, the position of the anomurous forms (hermit-crabs, &c.) has often been the subject of doubt. The special adaptations of some genera for particular modes of life have caused them to be thrown together; and no doubt they agree in possessing neither the powerful abdomen of the lobsters, nor the very much aborted one of the crabs. Yet the anomurous forms include markedly contrasted groups. The family Hippidæ, with its lobster-like cephalothorax and firm abdomen, differs greatly in aspect from the hermit-crabs. *Hippa talpoida*, a small species found along the whole eastern coast of the United States, inhabits sandy beaches exposed to the waves, at a zone very near low-water mark. It has a smooth oval form, and short and stout thoracic legs (second, third, and fourth pairs), enabling it to burrow backwards in the sand with marvellous rapidity. In life the antennæ are peculiarly crossed, with the flagella curved round the mouth so that the setæ, with which they are densely covered, all project inwards, and the function of the antennæ appears to consist chiefly in the removal of all parasitic growths or foreign bodies from the anterior parts of the body. The appendages of the mouth are not adapted for prehension or mastication, and the alimentary canal is found loaded with fine sand. The thoracic appendages have neither external nor superior elements (exopodites, epipodites); while the office of protecting and cleaning the gills is discharged by the small limbs corresponding to the fifth pair of ambulatory legs in lobsters, which are curved upwards and hidden beneath the carapace. The development of this form has been recently carefully described by Mr. Sidney Smith, of Yale College, in the *Transactions* of the Connecticut Academy, vol. iii. p. 311. They pass through larval stages very analogous to the zoëa stages of crabs, only being destitute of a large dorsal spine; and they then assume a form like the brachyuran megalops, with large eyes, and powerful abdominal swimming legs. But in this condition they buried themselves in sand with great alacrity. Thus it is determined that the embryonic development of Hippa, as well as of Albunea, studied by Claus, agrees much more closely with that of crabs proper than with hermit crabs or lobsters; and this publication by Mr. Smith furnishes an important addition to the evidence favouring the view that the Anomura are a heterogeneous group made up of specialised families of Brachyura and Macrura.

THE AMERICAN BISON.—Mr. J. A. Allen's valuable "History of the American Bison," so sumptuously produced by the Geological Survey of Kentucky and the Harvard Museum of Zoology, has excited so much interest that to supply the demand for it Dr. Hayden has republished almost the whole of the text in the ninth annual report of his survey of the territories, and as a separate pamphlet of 150 pages, with considerable additions by the author. One of the most interesting of these consists in the publication of a letter from Mr. J. W. Cunningham, of Howard County, Nebraska, on the domestication of this species. It appears that the bison has been crossed with the ordinary milch cow, and that half- and quarter-breds are not uncommon, and the cows yield extremely rich milk. They prove to be both hardy and tame. The colour of the bison and the majority of the distinguishing characters disappear after repeated crossings. The lump of flesh covering the dorsal vertebræ also becomes diminished. The preservation of a pure domestic breed of the bison does not seem so easy. In some instances where buffaloes have been broken to the yoke they have proved strong and serviceable, but rather unmanageable at times. Unless the breed is maintained in some way artificially, the wild species will no doubt before very long become extinct.

PRODUCTS OF ASSIMILATION IN MUSACEÆ.—Herr Emil Godlewski has recently investigated whether in the case of Musaceæ the first assimilation-product is oil or starch, which latter is the first product in most plants. Sig. Briosi had recently maintained that oil was first produced. The question which had to be solved, therefore, was whether these plants, when decomposing carbonic acid under the influence of light, exhale a volume of oxygen greater than that of the carbonic acid decomposed. If oil is formed from the carbonic acid this must be the case. Measurements which Herr Godlewski made to this end with *Musa sapientium*, gave negative results; the oxygen exhaled was not of greater volume than the carbonic acid decomposed. Sig. Briosi had failed to discover starch in the grains of chlorophyll of the mesophyll-cells of the leaves; while Herr Godlewski was perfectly successful also in this direction, perceiving numerous granules of starch in leaves from young specimens of species of both *Musa* and *Strelitzia*, which had been collected in the evening after a hot day.

FERTILISATION IN THYME AND MARJORAM.—Under the title of "Das Variiren der Grösse gefärbten Blüthenhüllen, und seine Wirkung auf die Naturzüchtung der Blumen," Dr. Hermann Müller reprints from *Kosmos* a paper containing many of the facts which have appeared from time to time with his signature in these columns. The special point to which he calls attention is the occurrence in many species of Labiatæ—*Thymus serpyllum*, *Origanum vulgare*, &c.—of two distinct forms, one with larger hermaphrodite protandrous, the other with smaller female flowers. The second of these two forms can manifestly only be fertilised by the former, and will disappear where the conditions of life are unfavourable; while the propagation of the first form is in no way dependent on the other.

A FOSSIL FUNGUS.—One of the most interesting recent discoveries in palæophytology has recently been made by Mr. Worthington Smith, in the detection, in the coal-measures, of a fossil fungus nearly allied to that which produces the potato blight, and which he has named *Peronosporites antiquarius*. Fossil fungi were not previously altogether unknown. Some years ago Mr. Carruthers, the keeper of the botanical department at the British Museum, detected mycelial threads among the cells of a fossil fern (*Osmunda*) from the Lower Eocene strata of Herne Bay; and Mr. Darwin has stated that fungus threads in a fossil state in silicified wood were shown to him more than forty years ago by the late Mr. Robert Brown. Messrs. Hancock and Atthey have also described in the *Annals and Magazine of Natural History* (4th ser. vol. iv. 1869, p. 121, t. ix. x.), under the name of *Archagaricon*, what may be a fossil *Peronosporites* from the Cramlington black shale. The specimen examined by Mr. Worthington Smith (the fungoid nature of the organism having been first suggested by Mr. Carruthers), was seen within the vascular axis of a *Lepidodendron*,

and is thus described by that gentleman :—It consists of a mass of mycelia and zoosporangia (or oogonia). Beginning with the mycelium, a close examination shows that it is furnished with numerous joints or septa. If, therefore, any reliance is to be placed upon the modern distinguishing characters of the now living species of the genera *Peronospora* and *Pythium*, as furnished by a septate or non-septate mycelium, the fossil parasite belongs to the former, and not to the latter genus, nor to any of the Saprolegnieæ. The oogonia do not agree with those of *Cystopus*. Within many of the fossil oogonia the differentiation of the protoplasm into zoospores is clearly seen ; but if any doubt could exist as to the exact nature of this differentiation, then other oogonia (or zoosporangia) on the same slide show the contained zoospores with a clearness not to be exceeded by any living specimens of the present time. It is a very remarkable fact that the oogonium precisely resembles, in size and other characters, average oogonia of the present day, especially those belonging to *Peronospora infestans*. The contained zoospores are, moreover, the same in form and dimensions with those of *P. infestans* when measured to the ten-thousandth of an inch. The organisms are, in fact, apparently identical ; and the average number of zoospores in each oogonium is also the same, viz., seven or eight. The aërial condition of the fungus has not yet been observed. Mr. Worthington Smith suggests, in conclusion, that we probably have, in *Peronosporites antiquarius*, one of the primordial plants from which both the great families of fungi and algæ may possibly have descended ; but should not this primordial plant have led a non-parasitic life?—for if parasitical, then this fact points to some pre-existing plant.

THE LAWS OF DIGITAL REDUCTION.—Hitherto there has been little explanation of the curious variation in the number and relative size of the digits in the vertebrata. Mr. John A. Ryder (*American Naturalist*, October) suggests that the number of toes is least where the mechanical strains are greatest, and impacts most frequent and severe. He quotes several cases in which the hinder digits are reduced more than those of the fore feet, and shows that in all of them the body in jumping or running pitches mainly upon the hind limbs. He looks upon the outer toes of man as in process of undergoing reduction, being now weaker and shorter than in any of the higher apes. The chrysochloris among moles is an instance of special reduction in the anterior extremity, and here the mechanical strains are most frequent and severe. Among fossorial animals the claws and toes are usually best developed on the fore limbs. The retention by certain groups, of digits in a very equal state of development in manus or pes, or both, is attributed to the equal distribution of strains on all.

THE BIRDS OF GUADALOUPE ISLAND.—This interesting fauna is dealt with by Mr. Robert Ridgway in the *Bulletin* of the Nuttall Ornithological Club for July. It is strange that only eight forms from this island, situated about 220 miles south-west of San Diego, are satisfactorily known, and their affinities are almost entirely with those of western North America. They are recognised by Mr. Ridgway, however, as specifically distinct, differing from their nearest mainland allies in the (1) increased size of the bill and feet, (2) shorter wings and tail, and (3) darker colours.

THE DISTRIBUTION OF FRESHWATER FISHES.—Dr. D. S. Jordan, the well-known American ichthyologist, has contributed to the *American Naturalist* for October some of his conclusions derived from long study of the fishes of rivers flowing in different directions, and under the most widely-varied physical conditions. He finds that in the case of rivers flowing into the ocean, the character of the fishes of the upper waters bears little or no relation to the place of discharge. The higher or the older the watershed between two rivers, the fewer species are common to both. Certain species (not including species of general distribution) occur on opposite sides of even the highest watersheds. When the watershed between two rivers is a swampy district, the same species are found in the head waters of both, though the faunas of the lower courses may be distinct. There is often a great difference between the forms in the upper and lower waters of a river, owing to differences in physical conditions. Some species are strictly confined to one river basin ; others are widely distributed. Usually the more southern rivers have the most peculiar and varied faunas. Species of the widest distribution often have breaks in their range which cannot be accounted for by any known facts. The characteristically American forms of freshwater fishes are, generally speaking, absent or rare in the waters of New England and of the Pacific slope. The larger the river-basin, the greater its variety of forms. Seventy species have been taken in the little White River at Indianopolis, representing forty-eight genera, twice as many as occur in all the rivers of New England. Other things being equal, a river whose course lies in a region of undisturbed stratified rocks, or of glacial drift, contains most genera and species. Certain forms appear generally distributed in a definite range, either without regard to the direction in which the rivers flow, or even bounded by parallels of latitude. In any river-basin the most abundant species (of small fishes) are usually (1) those peculiar to it, or (2) those of widest distribution.

EARWIGS (FORFICULIDÆ).—Linnæus seems to have known but two species of earwigs (*Forficula auriculata* and *minor*). Both were European, and had *Elytra dimidiata et Alæ tectæ*, and were placed among the beetles (Coleoptera). There are now about 250 species known which are found all over the world, and grouped in about thirty genera, of which the genus Forficula is by far the richest in species and the widest in its geographical distribution. Happily, too, it still retains the two first-named species, and it has also most justly given its name to the family. Entomologists will be glad to know that Mr. Samuel Scudder has just published a series of critical and historical notes on this family, in which he gives descriptions of all the known genera, and an alphabetical list with full synonyms of all the described species ; this most valuable list will make the study of these interesting insects an easy one. It is published in Parts 3 and 4 of vol xviii. of the *Proceedings* of the Boston Society of Natural History.

HUNGARIAN SPIDERS.—The first part of a work on Hungarian Spiders by Assistant-Director Otto Hermann, of Buda Pest, has just reached us. It forms a handsome royal-quarto volume, with three plates, and is printed in double columns, one in Magyar, and the other, fortunately for us, in German. This volume forms part of the *Transactions* of the Royal Hungarian Natural History Society, which is really to be congratulated on the appearance of this and the next work that we will mention. The present volume gives a sketch of the literature belonging to spiders, and forms one of the most generally interesting portions of the work, for it is most carefully elaborated, being divided into the bibliography of the older and the newer times. It further treats of the life-history of spiders in general, and of the geographical distribution of those species to be met with in Hungary. The next volume will contain the spiders met with in Hungary proper.

HUNGARIAN ROTIFERS OR WHEEL-ANIMALCULES.—A memoir on Hungarian Rotifers by Dr. Bartsch Samu is also published under the auspices of the Royal Hungarian Natural History Society, but it is written exclusively in Magyar, if we may except a short appendix containing brief descriptions of the new species determined by the author, and therefore unfortunately we can do no more than call attention to it.